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ABSTRACT

A study compared the relative effects of typographically cued or mapped text, intact text with signaling, and intact text without signaling on the recall and retrieval of information from prose passages. (Signaling, a noncontent aspect of prose, emphasizes certain aspects of the semantic content or points out aspects of the structure of content.) Sixty college students were randomly assigned to one of 12 experimental groups that read one passage for recall (responding to 12 questions without referring to the text) and then another passage for retrieval (responding to questions by referring to the text). The types of passage read (nonsignaled, signaled, or mapped) and the order of presentation of two passages were completely counterbalanced. No main effects were significant in the analysis of scores on the retrieval task, although the signaled version produced significantly better performance on questions about intermediate-level information. Consistent with results of the work of B. Meyer and others, this study showed that signaling produced insignificantly better recall of information on probed recall tasks. The results raise questions about the current practice in the field of text design of using typographic and spatial cues to highlight text information. (RL)

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# COMPARISON OF EFFECTS OF DIFFERENT FORMS OF PRESENTATION ON THE RECALL AND RETRIEVAL OF INFORMATION

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## INTRODUCTION

Recent efforts to analyze and describe the structure of text have focused on both explicating the pattern of interrelationships among ideas in a text (Frederiksen, 1975, 1977; Kintsch, 1974; Meyer, 1975, 1977) and on identifying and defining those non-content aspects of prose which are utilized to produce coherent and cohesive texts (Halliday & Hasan 1976; van Dijk, 1977). An important function of such stylistic features is to clarify the relationships which connect the propositions or ideas in a text, by indicating their relative importance within the overall information structure of text.

### Signaling Text Structure

One discourse device which serves this end has been described by Meyer (1975, 1980) as 'signaling'. For Meyer (1975), "signaling is a non-content aspect of prose which gives emphasis to certain aspects of the semantic content or points out aspects of the structure of content". Although studies of the effect of signaling on the comprehension and recall of prose have produced rather contradictory results to date, Meyer (1980) has attempted to explain these contradictions by identifying several factors which may influence whether signaling devices will affect text

processing. These factors include the reader's familiarity with the topic of the passage, the number and kind of logical relationships involved, and the reader's ability to infer relationships which are not expressed explicitly. Whether explicit signaling of text relationships is advantageous may also be influenced by a person's purpose for reading and the nature of the reading tasks.

## Mapping (Typographic Signaling) of Text Structure

The explicit marking of important relationships or information units within a text is the purpose of various methods of information mapping, such as those utilized by Armbruster and Anderson (1980) or Horn (1976). Mapping procedures abstract information units from coherent text and then typographically represent the content or function of the information in a unit and the relationships existing among various units. Chunking and blocking of text functons to separate and isolate units of information in text, with a resultant von Restorff effect (Glynn, 1980). Blocking also provides locative information that may be encoded into memory as a retrieval cue (Christie & Just, 1976). Labels are often applied to these information units in the form of headings, content markers, terminology markers, or marginal notes (Duchastel, 1982). Such labels should function to make the structure of a passage explicit, facilitating the

integration of information during reading (Wright, 1977). Thus mapping procedurtes employ typographic means to indicate relationships which may be marked by signaling devices in intact texts.

## Purpose of Study

The primary purpose of this study was to compare the relative effects of typographically cued or mapped text, intact text with signaling, and intact text without signaling on the recall and retrieval of information from prose passages. Passages used were those that were developed by Meyer (1975, 1977). Target information was identified as being at one of three levels in the content structure of a passage (high, intermediate, and low). Since information high in the content structure has been found to be recalled better even without explicit marking (Meyer, 1975, 1977), overt marking of textual information whether through signaling or typographic means, may enhance the recall or identification of information lower in the hierarchical structure of the passage. However, the benefit of explicit marking of text units or relationships may depend upon the reader's purpose. If a reader's aim is to locate and identify specific information, mapping procedures may be particularly useful,since they provide overt aid for the information search (Jonassen & Falk, 1980). On the

other hand, if a person's principle intent is to obtain some overall idea of the content of a passage, explicit mapping may provide no real advantage. Therefore, another purpose of this study was to compare participants' performance on probed recall and information retrieval tasks, using all three types of information presentation.

## METHOD

### Subjects

Subjects were 60 upper-level undergraduates enrolled in three sections of a reading methods course at the University of North Carolina at Greensboro. The population was predominately female (93%). Reading ability of students in the three sections was equivalent as determined by scores on the Extended Range Vocabulary Test (V-3) from the Kit of Reference Tests for Cognitive Factors (French, Ekstrom, & Price, 1963), administered as a measure of verbal ability (Anderson, Spiro, & Anderson, 1978).

### Materials

Three distinct versions of two passages were used for the study. These passages were those used by Meyer (1975), one concerned with nuclear breeder reactors and the other,

the use of anti-s-proteins for schozophrenics. Both Meyer's with-signaling and without-signaling versions of each passage were employed. The with-signaling version of the breeder reactor passage (506 words) containbed 96 words that signaled the importance of top-level rhetorical relationships in the content structure, as well as indicating the overall organization of the passage. These words were deleted from the non-signaled version. The signaled schizophrenia passage (638 words) contained 65 signaling words. To construct the mapped version of each passage (see Appendix),each content structure was analyzed and information at different levels was combined and blocked in information units of from one to four sentences, each separated by a line feed and horizontal rule. Two blocks in each passage converted the prose into tabular form. The rhetorical relationships that were signaled in the signaling passage were distilled into block labels (eg. Solution, Cause-Effect, Social Technological Problem) which were displayed in the left column adjacent to each block. That is, the content of these headings was similar to the content of the signaling. For blocks of prose that were not signaled in the with-signaling version, non-substantive content markers (eg. Definition, Comment) were used as labels. All passages were displayed on two typewritten pages.

Probed recall tests, each 12 questions in length, were

developed for each passage. The first three questions (eg. What is a proposed solution to problems presented in the passage?) probed recall of information high in the content structure of each passage. The next four questions (eg. What are the characteristics of younger schizophrenics that require treatment?) probed recall of information at an intermediate level within each content structure, and the final five questions (eg. Approximately how many schizophrenics are hospitalized?) probed recall of information in the lowest level of the content structure.

## Procedure

The experiment was conducted in one two hour class session. After completing the aptitude test, all of the subjets completed the recall task. Instructions contained in their packet of materials were read to them. These indicated that they were to read the first passage at their own rate, return the passage to the packet, and complete the twelve-item probed recall task. The recall test was not timed. Following a short break, directions for the retrieval task were read to the subjects. The instructions stated that they would be presented with a similar passage and a similar list of questions and allowed an unspecified amount of time to find the answers to the questions in the passage and to write them on their response sheet. A total

of thirteen minutes was provided for the retrieval activity, at which time they were told to immediately cease writing.

## Design

The sixty subjects were randomly assigned to one of twelve experimental groups (n=5). The types of passage read (non-signaled, signaled, mapped) and the order of presentation of passages (Breeder, Schizophrenia) were completely counterbalanced. The specific passages read by each group are presented in Table 1. The first six groups read the Breeder passage for the recall task; the second six read the Schizophrenia passage. The order was reversed for the retrieval task. The order of tasks was the same for all groups to standardize the presenation of directions. The experiment was conducted during assigned class time.

For both passages, key words representing the intended meanings probed by each question were identified and used to evaluate the correctness of each response. Correct responses for each participant were summed by group and then sorted by treatment for both the recall and retrieval variables. A 3X2 (treatment by passage) analysis of variance was performed on the mean scores of the sorted data for the recall and retrieval tasks. Since the tasks were independent, requiring vastly different comprehension skills, no comparison was made between recall and retrieval.

The mean scores in Table 2 clearly indicate that probed scores were higher for the retrieval task than for the recall task, since readers had the passage available for confirming their answers.

## RESULTS

No main effects for treatment or passage were sigfnificant. For the recall task, where subjects answered probed recall questions directed at content high, intermediate, and low in the content structure, no treatment effects were found at any of the levels. When scores were summed across levels, the treatment effect approached significance ($p=.07$), because of slightly higher scores with the signaling passages. The only consistent predictor of performance was verbal ability, as measured by the Extended Range Vocabulary Test, $F$ $(1,55)=12.15$, $p<.001$ when those scores were entered into a multiple regression equation with the treatment and passage variables and the interactions. Vocabulary scores accounted for 25% of the variance in total recall scores.

No main effects were significant in the analysis of scores on the retrieval task. However, an interaction of level with treatment type was significant, since for questions probing intermediate-level passage information, the signaled version produced significantly better

performance, $F(2,55)=5.08, p<.01$. The effects of verbal ability disappeared for the retrieval task, accounting for an insignificant amount of the variance when it was regressed along with treatment and passage on retrieval scores.

## DISCUSSION

Consistent with results of Meyer's work (1975; Meyer, Brandt, and Bluth, 1978) signaling produced insignificantly better recall of information on a probed recall task, as opposed to the free recall task that she used. The effects of signaling were consistent across the three levels of recall, that is no treatment by level interaction occured, which is consistent with Meyer's findings (1975) but dissonant to the expectations for the mapping treatment, which was expected to facilitate recall of information low in the content structure, since high level information is generally better remembered anyway. Since signaling focuses on rhetorical relations high in the content structure, it perhaps should have produced a greater advantage for top-level content.

The absence of significant effects for either the linguistic or the typographic signaling of content structure probably resulted from two factors. The expectation that the signals would function as retrieval cues during recall

was subverted by the retrieval cues provided by the probed recall task, that is, the questions acted as retrieval cues. A free-recall task, where no such cues would have been available, may have yielded more significant results for signaling.

The insignificantly decremental effects of typographically highlighting text structure evinced in this study was unexpected. It was hypothesized that those overt signals (labels) would function as strong retrieval cues. What appeared to happen was that in breaking prose into isolatd unbits, the textual coherence of the passage was destroyed. Any associational advantages of explicit marking of text were counterbalanced by the reduction of cohesion provided by intact text structure. Clearly, mapping procedures reduce textual cohesion. In fact, some of the participants registered confusion regarding the purpose of the mapped versions when told they would be reading a passage.

We expected that the mapped version of text would provide significant locational cues for the retrieval task. As long as the marginal labels accurately described the adjacent content, readers should be able to scan the headings to locate the information. The typographic and spatial cues in the mapped versions should function as access structures (Waller, 1979) which would facilitate retrieval of information, as had been previously confirmed

(Jonassen & Falk, 1980). One reason for the absence of such an effect was the length of the passage (Horn, Note 1). The mapping version provides more of an advantage the longer the passage, so this study should be repeated with longer passages. The lack of effect for the mapped version in the present study may also be attributed to subjects' lack of familiarity with the form of text, that is, an understanding of how to utilize the access structures provided.

In this study, in-text signaling did aid retrieval of intermediate information. Although the text itself is structured in some sense, this information may be hardest to identify (if not recall) in a passage. High-level, thematic information usually appears in the title and is repeated often at the beginning of the passage. But lower-level information, embedded in text, depends more upon signals or markers for its identification. This effect did not carry over to low-level information in this study, probably because the time limit imposed on the rtrieval task prevented subjects from completing the low-level questions, which appeared last in the list.

## CONCLUSIONS

Current emphasis in the field of text design is on the use of typographic and spatial cues to highlight text information. The results of this study suggest that we

should regard this endeavor cautiously. Coherent text, especially when information relationships are signaled within the text itself, obviously has its own advantages, among them, familiarity to the reader. Much additional work needs to be done, with longer passages and with different tasks, before unequivocal recommendations about displaying text can be

made.

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TABLE 1

PASSAGES READ BY EXPERIMENTAL CONDITION

| Experimental Group | Recall Task | | Retrieval Task | |
|---|---|---|---|---|
| | Topic | Version | Topic | Version |
| 1 | Breeder | Signaled | Schizophrenia | Non-signaled |
| 2 | Breeder | Signaled | Schizophrenia | Mapped |
| 3 | Breeder | Non-signaled | Schizophrenia | Signaled |
| 4 | Breeder | Non-signaled | Schizophrenia | Mapped |
| 5 | Breeder | Mapped | Schizophrenia | Signaled |
| 6 | ← Breeder | ← Mapped | ← Schizophrenia | Non-signaled ↗ |
| 7 | ← Schizophrenia | ← Signaled | ← Breeder | Non-signaled ↗ |
| 8 | Schizophrenia | Signaled | Breeder | Mapped |
| 9 | Schizophrenia | Non-signaled | Breeder | Signaled |
| 10 | Scizophrenia | Non-signaled | Breeder | Mapped |
| 11 | Schizophrenia | Mapped | Breeder | Signaled |
| 12 | ← Schizophrenia | ← Mapped | ← Breeder | Non-signaled ↗ |

TABLE 2

MEANS AND STANDARD DEVIATIONS BY TREATMENT

| | Content Level | Non-Sign. | | Signaled | | Mapped | |
|---|---|---|---|---|---|---|---|
| | | X | SD | X | SD | X | SD |
| Recall | High(3) | 1.45 | 0.69 | 1.70 | 0.73 | 1.35 | 0.75 |
| | Medium(4) | 1.10 | 1.02 | 1.60 | 0.68 | 1.05 | 0.76 |
| | Low(5) | 1.75 | 1.11 | 2.50 | 1.46 | 1.80 | 1.10 |
| | Total(12) | 4.30 | 2.15 | 5.80 | 2.17 | 4.20 | 1.28 |
| Retrieval | High(3) | 2.20 | 0.70 | 2.45 | 0.60 | 2.00 | 1.03 |
| | Medium(4) | 3.10 | 0.72 | 3.15 | 0.74 | 2.35 | 0.99 |
| | Low(5) | 3.95 | 1.31 | 3.70 | 1.30 | 3.75 | 1.29 |
| | Total(12) | 9.25 | 1.99 | 9.30 | 1.68 | 8.10 | 2.29 |

# BREEDER REACTOR

**Solution to Problem**

Breeder reactors produce more nuclear fuel than they consume.

**Advantages of Breeder Reactors**

The breeder type of nuclear reactors...

- make it feasible to utilize enormous quantities of low-grade uranium and thorium ores dispersed in the earth as a source of low-cost energy.
- would operate without adding noxious combustion products to the air.

**As a Result**

The U.S. Atomic Energy Commission, the nuclear industry, and the electric utilities have mounted a large-scale effort to develop the technology whereby it will be possible to have a breeder reactor generating electric power on a commercial scale by 1984.

**Nuclear Breeding**

Nuclear breeding is achieved by nuclear fission.

| Step | Procedure |
|---|---|
| 1 | Fissioning of each atom (such as uranium 235) liberates an average of more than two fast (high energy) neutrons. |
| 2 | One of the neutrons must trigger another fission to maintain the nuclear chain reaction. |
| | NOTE: Some neutrons are non-productively lost. |
| 3 | Remainder transform "fertile" isotopes of the heavy elements into fissionable isotypes. |

**Raw Materials**

| Raw materials for Breeder reactions | are transmuted into |
|---|---|
| Thorium 232 | Uranium 233 |
| Uranium 238 | Plutonium 239 |

**Review**

Breeding occurs when more fissionable material is produced than is consumed.

**Rule**

A quantitative measure of this condition is doubling time.

Doubling time = the time required to produce as much net additional fissionable material as was originally present in the reactor.

**Result**

At the end of the doubling time - reactor has produced enough fissionable material to refuel itself and another identical reactor.

**Rule**

An efficient breeder reactor will have a doubling time in the range of from seven to ten years.